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BOILER USING MERCURY SAVES HALF OF FUEL

The first mercury engine in the world for the production of power in commercial quantity is now in operation in the plant of the Hartford Electric Light company whose officials predict a saving of from 40 to 50 per cent. of fuel by its use. The invention is essentially a turbine engine run by mercury vapor. The whole electrical industry is interested in observations being made of its operation.

Incentive for a careful investigation of the properties of mercury vapor for power generation is given by the high cost of coal and its transportation, making it necessary to minimize fuel consumption. The mercury boiler was started up successfully in Hartford, Conn. early in September and has since been in regular operation, carrying a part of the commercial load of the local lighting system. Officers of the local lighting company say that it has carried approximately 3,500 K.W. of the Hartford load.

While the present installation is not of sufficient size to have any effect on total cost of power produced by the company at the present time, it is large enough to provide a working basis to figure the results that may be obtained eventually from larger sizes. The manufacture of these boilers is so intricate that it will be several years probably before the larger boilers can be in operation.

It is expected that the mercury boilers will be a very material improvement over the most modern stations, even those contemplating using 1,000 and 1,200 pounds of steam pressure. The new process will require only about one quarter of the fuel that is used with the best reciprocating engines.

The mercury vapor exhausted by the mercury turbine is sent to a condenser where it is cooled by water, just as in any ordinary power system. But the mercury vapor is so hot that the "cooling water" is turned into high-pressure steam. This steam is not wasted but is sent to a steam turbine from which additional power is obtained. This still further increases the efficiency of the system.

It is the object in making such installations in the future to replace the steam boilers in the large modern plants by a mercury boiler which will give nearly double the output in the same space. Consequently it will not be necessary for a general redesign of a station to obtain the benefit of better economy

The process was invented and designed by Dr. W. L. R. Emmet of the General Electric Company. As the characteristics of mercury vapor had never been thoroughly studied by other scientists, it was necessary for him to go into this general subject in great detail. It was found that no form of packing of the joints would resist the mercury vapor and a system of arc and acetylene welded joints was therefore developed.

In this connection it is of interest to recall that the Hartford Electric Light Company installed the first commercial size steam turbine in this country.

The possible efficiency of the mercury vapor process for the generation of electrical power is equivalent to that of internal combustion engines, its inventor, W. L. R. Emmet, consulting engineer of the General Electric Company, said in a statement requested by Science Service. Since the new process involves only simple rotation and is applicable to any kind of fuel, Mr. Emmet expects it to be "simple and practicable for application to a variety of purposes" just as soon as the commercial installation at Hartford is given a severe service trial and mechanical difficulties are fully overcome.

The mercury boiler and turbine is not yet ready for general commercial application, Mr. Emmet said, as the development of such a process involves a very large amount of experimentation and accumulation of experience, both in methods of construction and the proportioning of boilers and condensers.

In discussing its efficiency, Mr. Emmet said:

"The possible rate of gain which may be accomplished by proposed mercury vapor process, as compared with steam plants, is naturally dependent upon the conditions and efficiency of the plant with which comparison is made. To give an idea of the possibilities it may be said that, if we compare with a steam turbine generating plant, using 200 lbs. steam pressure, with the highest standards of efficiency in turbines and auxiliaries, the mercury steam combination with 35 lbs. gauge pressure in mercury vapor should give about 52 per cent. more output in electricity per pound of fuel. And, if in such a plant the boiler room is re-equipped with furnaces and mercury apparatus arranged to burn 18 per cent. more fuel, the station capacity with the same steam turbines, condensers, auxiliaries, water circulation, etc., would be increased about 80 per cent. As compared with higher steam pressures, such as are now being developed, the percentage of gain would naturally be less, but still very important."

The mercury is re-used many times, unlike the water used in steam boilers. Mr. Emmet expects that less than five pounds of mercury per kilowatt of capacity will be required when the process is operated on a large scale.

READING REFERENCE - Thomson, J. Arthur. The Outline of Science. Chapter XXIV, Applied Science. New York, G. P. Putnam's Sons, 1922.

SHENANDOAH FIRST USED NEW AIR MAP

The first chart of land areas on the Mercator projection to be used in aerial navigation was part of the equipment of the Navy dirigible Shenandoah, formerly the ZR-1, on her recent voyage to St. Louis. The chart included the states of New Jersey, Pennsylvania, and the northern parts of Maryland, Virginia and West Virginia. It was prepared by the U. S. Hydrographic office for the use of the giant airship, but copies will be available for other navigators of the air.

The chart was made from the topographic maps of the U. S. Geological Survey but with an important change. The Geological Survey maps are on what is known as a polyconic projection, that is, they are drawn as if they were to be projected on the surface of a cone tapering northwards toward the pole. Charts drawn on the Mercator projection are drawn as if to be projected on a cylinder.

Both of these projections are necessarily not quite accurate, since the surface of the earth is approximately that of a sphere and it is impossible in the nature of things to draw a perfectly accurate map of such a curved surface on a flat piece of paper such as a chart. All maps are therefore drawn according to different projections, designed to minimize the error and to be most convenient for the purpose in hand. On a Mercator map the distance between parallels of longitude is always the same. Since on the sphere of the earth these parallels all meet at the poles a Mercator map shows a great distortion of areas near the poles, which appear much larger than they are. In a polyconic map the parallels of longitude converge in the direction of the poles although not exactly as they would on the surface of a sphere.

For purposes of navigation, however, the Mercator projection maps are superior since they permit the navigator to fix his latitude and longitude accurately by means of what are known as "Sumner lines", worked out as a result of two observations of the sun with a brief interval between.

The Hydrographic office therefore devised a new method for the reduction of polyconic to Mercator projection maps and the first result of it was the chart used by the Shenandoah. The chart shows lines of equal compass variation, contour lines, main highways, railroads, rivers, and the built up parts of cities and towns.

FORKED TAIL MONKEYS AND LOST TRIBES SOUGHT IN CHINA

Monkeys with forked tails will be one of the objectives of an exploring expedition of the National Geographic Society which will start shortly for one of the remotest parts of China, the province of Kweichow. The main object will be the study of the non-Chinese tribes who dwell there, unassimilated by the surrounding Chinese population after more than 2300 years of contact. Botanical specimens will also be collected over a spacious region virgin to scientific study.

Much doubt exists as to the possibility of finding a forked tailed monkey although such a creature has been described in Chinese literature as inhabiting this region, but a species of monkey believed to be the largest non-anthropoid

species in the world is believed to dwell there, the skin of one having been brought out by an explorer. Few white men have ever penetrated this remote region, as large as Missouri, as populous as Pennsylvania, and as inaccessible as Tibet. It lies back of the great mountain ranges which bound the western watershed of the Yangtze river.

Returning travellers from this far distant province have told stories of the strange inhabitants, altogether unlike the Chinese and probably the remaining original stock of the land settled there centuries before the Chinese penetrated from the north and west. One unscientific yet travelled visitor relates having seen types resembling the Gurkha, the South Sea Islander, the American Indian, and the Negro.

There are thought to be about two million of these people whom the National Geographic Society's expedition will study. It will be led by Frederick R. Wulsin who will take with him from Peking a party of Chinese assistants for a reconnaissance, and, if facts warrant it, a later expedition with a complete scientific staff.

HOW TO HEAT YOUR HOME

By Samuel S. Wyer,
Associate in Mineral Technology,
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How To Burn Gas

Manufactured gas is man-made by "transmutation of crude, dirty inert coal into energetic gas." Natural gas is made by nature and is transmitted to the consumer in its natural state. The heating value of natural gas is about twice that of manufactured gas. That is, it takes two cubic feet of manufactured gas to furnish the heating energy of one cubic foot of natural gas. Because of its higher heating value, natural gas requires twice as much air for combustion as is required by manufactured gas, otherwise the two gases are handled just the same in the home appliance. Natural gas does not have a distinctive offensive odor like manufactured gas, and this makes the detection of natural gas leaks in the home more difficult. The flame temperature of the two gases are practically the same.

Large volumes of gas, to be burned, must have some of the air mixed with the gas before the gas reaches the flame. In Bunsen or blue flame burners, the air is sucked into the mixer by the aspirating action of the gas. The air shutter must be adjusted until a clean blue flame is produced. A yellow flame with this type of burner is an indication of waste.

Small volumes of gas forced out through a small hole, about the diameter of a pin, can get enough air to insure perfect combustion with a yellow flame. This type, known as the luminous-flame burner, can be used only for room heating purposes and then only in positions where the flames do not impinge on each other or on any surface.

Grid or open-top stoves are desirable for good service so as to get the most direct path for the heat from the flame to the food. Many natural gas cook stoves have solid tops and burners $2\frac{1}{2}$ to $3\frac{1}{2}$ inches away. This is wrong. Such stoves always waste gas and frequently will not give any service when the pressure is low.

Natural gas appliances should always be adjusted for low pressure only, and only low pressures of one to two ounces used. This would save gas and give better service during the inevitable low pressure conditions when the demand is greater than the available supply.

Even with perfect combustion, it is not desirable to have carbon dioxide and water vapor, that must always be formed, remain in the room. If the burners are not correctly adjusted, if something goes wrong so that the heater begins to generate carbon monoxide gas, which is a poison, the use of adequate flues is a good insurance against accident.

Gas lighting should be from incandescent mantle lamps only. It is squarely against the public's interest for any community to maintain a candle power standard for manufacturing gas so as to permit the use of open flame burners. The lamp must be closely adjusted if efficient and satisfactory results are to be obtained. Hissing or roaring sounds are indicative of excessive or bad adjustment. Adjust the lamp by adjusting the air shutter and gas needle valve of the burner so as to obtain the maximum illumination and a quietly burning lamp.

Rules For Correct Use of Gas

1. Blue flame burners must be properly adjusted and burn blue only; 2. The inner cone of the blue flame must not strike any surface; 3. Solid tops on cook stoves should not be used; use grid or open tops only; 4. Top burners on cook stoves should be only $1\frac{1}{4}$ inches below the cooking vessel, and gas used at low pressures only; 5. Radiants in radiant fire heaters should never be operated so the radiants glow more than 3/4 of the distance from bottom to top; 6. The flame on "luminous-flame" heaters must not strike each other or any surface; 7. Incandescent mantles must not hiss or roar; 8. Flues should be used on all water heaters and room heaters used continuously; 9. Never use gas in any coal burning appliance, it will always be wasteful; 10. Water heaters should have enough heat absorbing surface to get the heat into the water and have the gas combustion products cool where they leave the heater.

VII. How To Burn Oil

The only way that the best results can be obtained in using oil for either cooking or house heating is to burn oil in appliances either specially built for oil or for gas. This is because the ordinary coal burning appliance does not have enough heat absorbing surface to get the heat produced into the room and, as a result, the burning of oil in coal appliances will always be wasteful.

When gas is not available, oil is much more desirable than any solid fuel for cooking and hot water heating. For house heating, in properly constructed

furnaces, oil is desirable and, if properly handled, because of ease of control, can be made to give satisfactory service. However, the present over production in oil, in the light of past experiences, is merely temporary and fuel oil prices may be reasonably expected to be materially increased again after the oil industry goes back on a normal basis.

Mechanisms for burning oil may be divided into two general classes:

A. Wick burners. These work on the same principle as the ordinary kerosene lamp. The wick by capillary attraction, raises the oil through the wick from the reservoir below to the wick top where it is burned. These are feasible only for cook stoves, hot water heaters and small room heaters.

B. Atomizing or vapor burners. In these the oil is changed in form, it is broken up or atomized or converted into vapor by pressure or heat or both pressure and heat. The pressure for atomizing may be secured through the medium of a hand pump similar to the automobile tire pump or through an electric motor driven mechanism; the heat for starting the burner from alcohol or gas. The various oil heaters on the market vary so largely in construction and operating details that general instructions for proper adjustment cannot be given.

The wooden barrels or steel drums in which fuel oil is shipped frequently permits small particles of dirt to get into the oil. All oil burners somewhere in their construction have small openings through which the oil must pass. Dirt in the oil causes these to clog. Therefore the oil should be carefully strained before it is placed in the storage tank in the home.

Many claims have been made alleging that certain burners "burn such and such amount of air" and the statements are so worded that the public gets the impression that this air for burning is something peculiar or unique with oil burners and therefore, since nothing in the world is so cheap as air, that the particular burner will give unusually cheap service. All fuels require air for burning and this is not a peculiar feature of oil at all. Such misleading statements, of course, ultimately must lead to a reaction against oil burner installations.

LABORATORY WORKERS CATCH RARE DISEASE

Two cases of Malta fever, a highly infectious but seldom fatal disease and one very rare in this country, have occurred among the laboratory staff of the U. S. Public Health Service Hygienic Laboratory in Washington where the disease is under investigation. Both patients are now convalescent.

Goats are subject to the disease, and a few months ago there was an outbreak of it in Arizona in sections where unpasteurized goat's milk was extensively used as food. Doctors and workers from the Hygienic Laboratory were sent to the spot and after quelling the outbreak returned to Washington where further inquiry as to methods for the prevention and cure of the malady were undertaken. The two cases among the laboratory workers followed.

Malta fever, as its name indicates, was formerly very prevalent on the island of that name and to a less extent throughout the whole Mediterranean basin where

goats' milk is a staple food. While rarely fatal it causes disability for long periods in many cases, convalescence being interrupted and tedious.

The two cases of this disease among workers in the Hygienic Laboratory call renewed attention to the risks run by the doctors and scientists there who handle deadly germs with the same indifference to danger that is shown by workers with high explosives. Not long ago there were six cases in the laboratory of a rare disease known as tularemia. Rabbits and other small mammals have been found to be infected with this disease which is easily transmitted to human beings, causing a long continued fever and prolonged disability, although the death rate is practically zero. So infectious is this disease that practically every laboratory worker who deals with it catches it sooner or later.

In a more serious class is the deadly Rocky Mountain spotted fever, a disease which because of its prevalence in parts of the northern Rocky Mountain region has caused the abandonment of settlements and ranches and serious loss of life and property. Cattle are subject to it and it is usually transmitted to man through the bite of a certain species of tick. The mortality in man runs from 50 to 90 per cent.

Although it has already killed several workers in the U. S. Public Health Service, the Hygienic Laboratory is on its trail, seeking a method of immunization or cure. The work is in charge of Dr. R. R. Spencer, who is regarded by his fellow workers, themselves used to dealing with such unpleasant diseases as plague, smallpox, and typhus, as literally on the firing line of science. For the unseen bacteria are more deadly than enemy bullets and give no warning until their victim is stricken down.

READING REFERENCE - Keen, William Williams. Medical Research and Human Welfare. Boston, Houghton Mifflin Company, 1917.

BIOLOGICAL BUREAU STARTS NEW SCIENTIFIC FUR FARM

A new experimental fur farm, stocked in part with unscented skunks, has just been established by the United States Biological Survey on a twenty-acre tract of wooded land in Greenfield Township, Saratoga County, New York. F. G. Ashbrook of the Bureau's Division of Economic Investigations has charge of the transfer of the animals from the former and more inaccessible site at Keeseville.

Present plans call for a series of modern pens to accommodate silver, black, and red foxes, martens, minks, fishers, and skunks. The breeding habits of these fur bearers will be studied and methods of combating disease among them will be worked out.

At Keeseville last year, martens were successfully bred in captivity for the first time. This work will be continued at the new site and efforts will be made to discover how to breed the fisher, another beautiful fur animal which has hitherto baffled the commercial raiser.

Experiments in fighting disease, such as distemper and hookworm, will be carried forward. Hookworm is one of the most prevalent diseases among captive foxes, and the Bureau has worked out an effective means of killing the parasites which produce it by use of the chemical, carbon tetrachloride.

Much trouble was formerly had in administering this remedy, however, as the capsules in which it was given were often broken in the mouths of the foxes with the result that the carbon tetrachloride often went down their windpipes and suffocated them. Recently the investigators found that by use of a more gelatinous capsule which would mash without breaking, this trouble could be largely prevented. Methods of artificial respiration, similar to those used to revise an apparently drowned man, were also worked out by which the accidentally gassed foxes could be resusitated.

The skunks raised on the farm have all had their scent sacs removed. This gland operation does not injure the breeding or fur value of these animals which have been held in such bad odor, but makes them more agreeable from an olfactory standpoint.

READING REFERENCE - Nelson, E. W. Wild Animals of North America. Washington, National Geographic Society, 1918.

VITAMIN CONTROLLING STERILITY EXTRACTED FROM FOODS

One more step toward the isolation of the new vitamin X that controls reproduction has been taken by Drs. Herbert M. Evans and Katharine Scott Bishop of the Anatomical Laboratory of the University of California.

These physiologists found that if rats were fed on a certain diet of so-called "pure" food they are rendered sterile and will not reproduce. When they were fed also some such substances as lettuce, wheat embryo, alfalfa leaves, they became normal in their sex function. Dr. Evans has now determined that the substance, vitamin X, can be extracted from favorable food by alcohol and ether and that these extracts cure animals of proven sterility.

That male rats as well as female are made sterile by lack of vitamin X has also been proved by laboratory work just completed.

READING REFERENCE - Eddy, Walter H. The Vitamin Manual; a presentation of essential data about the new food factors. Baltimore, Williams and Wilkins, 1921.

It is planned to replace the Mexican dollar and foreign coins used in China with a new uniform Chinese silver dollar to be minted in Shanghai.

PRIZE ESSAY CONTEST FOR SECONDARY SCHOOL STUDENTS

Under a grant of $10,000 from Mr. and Mrs. Francis P. Garvan of New York City, in memory of their daughter Patricia, the American Chemical Society has instituted a Prize Essay Contest among secondary school students. Six prizes of $20. in gold and certificates of honorable mention will be awarded in each state and the District of Columbia for the best essays submitted during the school year 1923-1924 in each of the following topics:

1. The Relation of Chemistry to Health and Disease.
2. The Relation of Chemistry to the Enrichment of Life.
3. The Relation of Chemistry to Agriculture and Forestry.
4. The Relation of Chemistry to National Defense.
5. The Relation of Chemistry to the Home.
6. The Relation of Chemistry to the Development of the Industries and Resources of Your State.

From among the winners of State prizes a National Committee will select the best essay in each of the six classes. The writers will be awarded four year scholarships at Yale University or Vassar College, pursuant to the wishes of the donors of the prize.

The purpose of these prizes, namely the stimulation of interest in chemistry among the younger generation, has received the official endorsement of the American Chemical Society, of the Bureau of Education of the Department of the Interior, and of the National Research Council.

Further information regarding these prizes will be supplied by the Committee on Prize Essays, Munson Building, 67 Wall Street, New York, N.Y.

NATURAL GAS GASOLINE IS GOOD REFRIGERANT

That natural gas gasoline may be used to advantage as a refrigerant is asserted by L. D. Wyant, chemical engineer of the Bureau of Mines, who has recentl completed an investigation of its possibilities in those lines. In the experiments conducted it was shown that a temperature in a "cold room" of 14 to 16 degrees above zero Fahrenheit was easily obtained.

Natural gas gasoline has the advantage over ammonia, the commonly used refrigerant, in that its vapors are not poisonous in low concentrations while those of ammonia are dangerous in the concentration of half of one per cent. It requires less pressure than when liquid carbon dioxide is used as refrigerating agent, and produces more cold than does liquid sulphur dioxide, which also is poisonous. These advantages are believed to offset its inflammability, as danger from that source may, Mr. Wyant says, be avoided by ventilation. It is asserted that a concentration of gasoline vapor equivalent to a fatal concentration of ammonia would not be inflammable.

READING REFERENCE - Caldwell, Otis W. and Slosson, Edwin E. Science Remaking the World, page 12. New York, Doubleday, Page and Company, 1923.

TABLOID BOOK REVIEW

INSECT STORIES by Vernon Kellogg, author of American Insects, Nuova, the New Bee, etc. D. Appleton and Company, 1923. $1.75.

Vernon Kellogg takes a very happy means of introducing the reader to the minute, busy and surprising life of the insect world. He takes you straight to the haunts of the insects and in simple language tells the story of how they live and what they do. The habits and actions of these tiny lives he writes of in delicate, story-like form and with a vein of humor which is delightful. In the first chapter you are introduced to "a narrow waisted mother," the wasp, and learn of the remarkable manner in which she secures food for her young. In other chapters you meet the dragon-flies, the beetles, the May-fly that lives only a few hours, and such a humdrum soul as "Fuzzy," the bee, into whose complex existance in the hive one is initiated. The chapter about "Argiope of the Silver Shield" is an absorbing account of the spider, his web weaving and method of feeding. There is a thrill too in Dr. Kellogg's picture of "Argiope" and the victoms caught in his toils. The whole book forms a very simple but accurate and illuminating introduction to the insect world.

Iceland is using refrigeration this year for the first time in her history in the exportation of large quantities of mutton, formerly salted and barreled.

Radio messages broadcast from Los Angeles, Salt Lake City, and Chicago, were recently received daily by engineers of the U. S. Geological Survey while traveling in the bottom of the Grand Canyon of the Colorado.

Three American buffaloes have been given to the Mexican Government by the United States.

There is not a single tree that grows in the United States that also grows naturally in northern South America.

Hippocrates, the father of medicine, mentioned the therapeutic use of fish oils.

Bronze, the only tool metal known to our ancestors of 8,000 years ago, was invented independently in the Near East and by the Peruvian Indians.
